WORKING PAPERS

Bridging the Gap Between Evidence-based Innovation and National Health-sector Reform in Ghana

John Koku Awoonor-Williams
Ellie S. Feinglass
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John Koku Awoonor-Williams is District Director of Medical Services, Nkwanta District, Nkwanta Health Development Centre, Ghana Health Service, Volta Region. Ellie S. Feinglass is Staff Research Associate and Rachel Tobey is Consultant, Policy Research Division, Population Council. E-mail: efeinglass@popcouncil.org. Maya N. Vaughan-Smith is Mellon Fellow, Nkwanta Health Development Centre, Volta Region, Ghana. Frank K. Nyonator is Director, Policy Planning, Monitoring, and Evaluation Division, Ghana Health Service, Accra. At the time this article was written, Tanya C. Jones was Staff Research Associate, Population Council, Policy Planning, Monitoring, and Evaluation Division, Ghana. James F. Phillips, Senior Associate, Policy Research Division, Population Council.

ABSTRACT

Although experimental trials often identify optimal strategies for improving community health, transferring operational innovation from well-funded research programs to resource-constrained settings often languishes. Because research initiatives are based in institutions equipped with unique resources and staff capabilities, results are often dismissed by decisionmakers as irrelevant to large-scale operations and national health policy. This article describes an initiative undertaken in Nkwanta District, Ghana, focusing on this problem. The Nkwanta District initiative is a critical link between the experimental study conducted in Navrongo, Ghana, and a national effort to scale up the innovations developed in that study. A 2002 Nkwanta district-level survey provides the basis for assessing the likelihood that the Navrongo model is replicable elsewhere in Ghana. The effect of community-based health planning and services exposure on family planning and safe-motherhood indicators supports the hypothesis that the Navrongo model is transferable to impoverished rural settings elsewhere. This finding confirms the need for strategies to bridge the gap between Navrongo evidence-based innovation and national health-sector reform.

Mortality and fertility rates in rural West Africa are among the highest in the world. Although research has identified solutions to various maternal and child health challenges, few findings have had any tangible impact on national programs. Successful experimental studies often fail to influence large-scale operations because the resources that are directed to monitoring and evaluation inadvertently produce nonreplicable service-delivery capabilities. Consequently, research-based innovations are rarely expanded beyond their original target areas, representing lost opportunities to apply research findings to marginalized groups on a large scale (Simmons and Shiffman 2003). Although rigorous experimental trials that test health and demographic hypotheses are often essential for informing advances in health policy, responding to policy questions in this manner is inherently problematic; research that is designed to measure program impact often requires unique and sophisticated institutional capabilities, thus compromising the relevance of such results to broader policy. This article considers the results of transferring a community health program from a well-funded research setting to a more typical resource-constrained rural health district in Ghana. Previous studies explore the process of this program transfer and how it relates to the prospects for organizational change within the national Ministry of Health (MOH) (Phillips et al. 2003).

Launched in 1999, Ghana's Community-based Health Planning and Services (CHPS) Initiative currently operates at varying levels in 104 of the country's 110 districts. CHPS is derived from policies designed to scale up lessons from the Navrongo Health Research Centre's (NHRC) Community Health and Family Planning Project in rural northern Ghana—an experimental study conducted since 1993. Essentially, CHPS involves shifting health services from centrally located delivery points to remote, village-based facilities. Individual communities' assumption of responsibility for mobilizing traditional social institutions, local resources, and volunteer labor is a major component of CHPS's success. CHPS operations research initiatives are dispersed throughout Ghana, accompanied by programs of exchange and replication. This decentralized process, based on communal values and decisionmaking, is designed to increase health equity in rural areas by translating local research innovations into national policy implementation.

The Nkwanta District, in Ghana's Volta Region, has pioneered the implementation of the national CHPS initiative. The hypothesis being tested in Nkwanta assumes that operations developed and evaluated in an experimental setting can be transferred to and have an impact in typical rural settings with limited resources for health services and research. Testing this hypothesis represents a trial of the "Hawthorne Effect," which is often cited as the primary rationale for rejecting the relevance of experimental results to large-scale program operations. Addressing the Hawthorne hypothesis requires unobtrusive, low-cost research on the replicability of experimental findings and the sustainability of the scaling-up process (Phillips et al. 1984; Phillips 1988 and 1990; Nyonator et al. 2003).[1]

The Navrongo experiment, which is based on a rigorous experimental study, has enabled researchers and health administrators to derive causal inferences about the impact of experimental project interventions in Ghana's Kassena-Nankana District. The

Nkwanta initiative examines the plausibility that the effects of the Navrongo experiment are robust in a similarly isolated, albeit nonresearch setting. As a critical link between the experimental study in Navrongo and the national CHPS scaling-up effort, Nkwanta's experience argues less for the results than for the process itself. Nkwanta's district-level survey can be understood best as a plausibility assessment, designed to test the transferability of the Navrongo model, rather than as an evaluation intended to establish causality. If variable intensity and duration of exposure to the CHPS program produce a dose-response relationship, claims of plausibility are strengthened (Habicht et al. 1999). If observed CHPS effects are consistent with those of the Navrongo experiment, stakeholders have a compelling basis for asserting that program effects observed in Navrongo are not to be attributed to Hawthorne effects, but are indeed replicable in other cultural and ecological zones. This article discusses the effect of CHPS on Nkwanta's family planning and safe-motherhood indicators as an example of the successful application of the Navrongo model in other districts in Ghana.

THE NAVRONGO EXPERIMENT

Since the 1978 Alma Ata Conference, which focused on expanding access to affordable, high-quality preventive and primary care, "Health for All" has become a central pillar of Ghana's national strategy (Adjei et al. 2002; Ghana Health Service 2002; Akosa et al. 2003). In 1990, however, despite more than a decade of commitment to this policy, universal coverage remained a distant dream; more than 70 percent of all Ghanaians were living in rural areas that were at least 8 kilometers from a health-care facility. At the turn of the millennium, infant mortality rates in rural areas were 50 percent higher than those in urban settings (MOH 1998). Throughout the country, inadequate roads and transportation maintain marked inequities in access to care.

Although a broad political consensus has existed throughout the post-Alma Ata era with regard to the need for community-based health services, the relative merits of alternative approaches to developing such a system of care have been the subject of ongoing discussion and debate. One view, represented by the UNICEF-sponsored "Bamako Initiative," emphasized the potential benefits of mobilizing traditional chieftaincy, lineage, and social network systems for convening health committees, recruiting volunteers, and maintaining basic pharmaceutical supply kits. Community governance provides low-cost mechanisms for dispensing essential drugs, maintaining revolving accounts, and providing essential health services (Knippenberg et al. 1990). While volunteer programs have had a long legacy of international support, the full range of preventive and curative care—such as safe-motherhood interventions, antibiotic therapy, comprehensive family planning, and other essential services—requires technical expertise that only trained health professionals can provide (Amonoo-Lartson 1981; Agyepong and Marfo 1992; Agyepong 1999). For this reason, volunteer services were controversial. The feasibility of placing nurses in community locations was also debated, because facilities for resident clinical services were not available, and the cost of establishing sustainable community operations was prohibitive, given available resources.

The MOH launched an experimental study to identify practical means of overcoming operational constraints to effective community-based care. The implementation process would generate a functioning prototype of community services for statistical evaluation. Phases were designed to develop a service model, to extend it to communities throughout Kassena-Nankana District, and to test its impact on fertility and mortality.

Launched in 1993 in Kassena-Nankana, an impoverished rural district of northern Ghana, the Navrongo experiment examines the relative mortality and fertility impact of mobilizing two sets of existing resources. The Ministry of Health dimension reorients existing workers to community-based health care. With this new training, nurses—known as community health officers—are redeployed to village resident locations.[2] The *zurugelu* ("from-the-people") dimension aims to mobilize the previously untapped cultural resources of chieftaincy, social networks, and village gatherings in order to promote community accountability, volunteerism, and investment in health services. Because these two dimensions can be implemented independently, jointly, or not at all, a four-cell experiment is implied by the design (Binka et al. 1995).

During the pilot phase (see Nazzar et al. 1995), conveniently located clinics, known as community health compounds, were constructed by volunteers in pilot villages. Operating from the compounds, nurses were trained and equipped to provide outreach service delivery at the client's doorstep in 90-day coverage rounds. Health services, encompassing a wide range of curative and preventive care, included comprehensive family planning services and follow-up. In addition, community health officers supervised traditional birth attendants, assisted in uncomplicated deliveries, and conducted community diplomacy and communication activities to promote CHPS services.

The objective of the pilot phase was to build legitimacy, understanding, and support for family planning and reproductive health services by accessing male social networks. Volunteers were recruited and trained to provide outreach services, including education, referrals, and a limited range of health services. This arm of the study involved both convening a community health committee constituted by the council of chiefs and elders and conducting *durbars* (regular community forums), to encourage open dialogue regarding health and family planning services.

The pilot set the stage for a factorial experiment designed to assess the impact of the proposed configuration of care (Binka et al. 1995). By 1996, the Navrongo experiment was fully functioning as a districtwide study. Preliminary results reported in 1998 indicated that the core strategies were working (NHRC 1998). By the end of 1999, fertility decline was evident. Baseline total fertility rates of 5.5 births per woman of reproductive age were decreased by nearly one birth where community-nurse posting occurred in conjunction with community mobilization (Debpuur et al. 2002). Child-survival effects were seen as well. Although neonatal mortality has not been affected by project activities, and effects on infant mortality are not significant, posting nurses to rural communities was associated with a 50 percent reduction in the odds of childhood mortality (Pence et al. 2001).

THE TRANSFER OF INNOVATION

Success in Navrongo stimulated the implementation of various activities in Nkwanta District.[3] The ten Ministry of Health regional directors were informed of progress in Navrongo and invited to review implications of the project for operational change. To build consensus for adopting the Navrongo model, arrangements were made for the entire Nkwanta District health management team (DHMT) to observe the project firsthand. This step was critical because Ghanaian social norms place a high value on communal values and collective decisionmaking. In the case of the Nkwanta DHMT, the nurses were initially apprehensive because community posting was viewed as a personal sacrifice entailing considerable risk to family life, comfort, security, and social relations. Moreover, the logistics required to launch community-based services seemed daunting, because adopting this new approach would add substantially to the nurses' workload rather than simply replace or restructure existing functions.

These concerns were assuaged by direct exchange between peer counterparts in Navrongo and Nkwanta. Practical field demonstration of service operations introduced the Nkwanta DHMT to the innovative elements of the Navrongo model and assured them of the feasibility and importance of reorienting health-service delivery accordingly.[4] This thorough understanding of the Navrongo model could not have been realized in a classroom environment. Following one week of intensive joint community service delivery, Nkwanta staff began planning the implementation of a pilot in their home district.

In 1998, soon after this exchange, the Ministry of Health convened the first of a series of "National Health Forum" conferences for disseminating results and reviewing the progress of the Navrongo experiment. All 110 district health management teams were invited to the forum, together with regional health administrators and directors of MOH divisions in Accra, comprising the country's entire senior health policy and implementation staff. Participants engaged in an open debate regarding the implications of the Navrongo experience for national policy. Some participants argued that the unique institutional resources in Navrongo were fundamentally responsible for the program's success and that when replicated in more typical rural settings, its impact would diminish. Others asserted that the process of observing staff, measuring results, and interacting with communities had subtle and nonreplicable effects arising from the tendency of participants to view research activities as tantamount to supervisory oversight. This interchange suggested that evidence of the program's impact in Navrongo alone would not suffice to mobilize the political will essential for scaling up.

Although agreement was reached regarding the program's impact on health-seeking behavior and outcomes, its application in other contexts remained untested. Senior officials emphasized the need for a project that would serve as a logical intermediate link between Navrongo's sophisticated research site and the resource-deprived settings that are more typical of rural areas of Ghana.

Establishing the credibility of Navrongo's results ultimately required testing the feasibility and impact of this approach in other settings where realistic resource constraints would apply, typical administrative systems would prevail, and complex and

diverse social conditions would require creative solutions. In responding to these challenges, Nkwanta District pioneered the implementation of a national program to scale up the Navrongo model.[5]

THE NKWANTA SETTING

Nkwanta District, which spans more than 5,500 square kilometers, is the poorest and most remote district in the Volta region (see Figure 1). Ranking among the most impoverished districts in Ghana, its economy is dominated by subsistence agriculture and fishing. The district lacks paved roads, electrical power, telephones, and FM radio reception. The population has no access to pipe-borne water, depending primarily on boreholes and hand-dug wells for drinking water. Development is limited by low levels of educational attainment. Health services are rudimentary, and a single physician serves the district's 187,000 residents. Statistics on health status in the district are indicative of the profound effects of isolation and poverty on the residents' well-being. The high prevalence of measles, malaria, and other communicable diseases is compounded by the inaccessibility of health facilities. The district is characterized by a high rate of infant mortality attributed to preventable causes. Water-borne diseases, such as schistosomiasis and guinea worm, are endemic.

Although a small hospital was established in Nkwanta in 1997, health facilities were grossly inadequate. Only four health-care delivery points functioned in three of Nkwanta's subdistricts, and there was no district hospital; the remaining two subdistricts had neither private nor public health-care facilities. Staff were typically deployed to clinics situated far from most communities, and outreach services were sporadic and poorly managed. Both family planning and childhood immunization coverage in Nkwanta were persistently low, and approximately 25 percent of all children younger than five suffered from severe malnutrition.

Nkwanta DHMT data from 1996 indicate that only 11 percent of the district's newborns received diphtheria-pertussis-tetanus immunization; bacille Calmette-Guérin (BCG) coverage was only 21 percent; and measles coverage was just 22 percent (Nyonator 1996). Family planning practice was rare—a conclusion that has been confirmed by routine service-provision data, as well as survey data from 2000 indicating that the prevalence of modern contraceptive use was just above 3 percent. In the three years prior to the launching of CHPS, an average of eight maternal deaths was reported each month, implying a maternal mortality rate well in excess of 1,000 deaths per 100,000 live births.

Although both Navrongo and Nkwanta lack a modern economy and experience profound isolation from modern institutions and secular government, the districts differ markedly with regard to their culture and ecology. Whereas Navrongo has two ethnolinguistic groups, each residing in dispersed settlement areas of geographically contiguous zones, Nkwanta settlement patterns are clustered by hamlet, each with multiple ethnolinguistic groups. As many as five languages may be spoken in a single village, with each group led by its own chieftaincy and lineage system. This linguistic diversity presents unique challenges for efforts designed to encourage behavioral change

and for health education. Finally, whereas Navrongo has extensive resources for equipment and logistics support embedded in its research protocol, Nkwanta's less-sophisticated institutional capacity is more typical of district health systems in other rural districts of Ghana.

THE COMMUNITY-BASED HEALTH PLANNING AND SERVICES INITIATIVE

Introducing community health services is a complex process involving the establishment of new work routines, supervisory systems, and modes of work. A rigorous regimen of strategic planning was created to clarify critical steps and milestones required for making the transition. In 1998, the planning process was launched by deploying service-implementation teams from Nkwanta to Navrongo, where they worked for two weeks as counterparts to colleagues who had already launched the program. The Navrongo orientation was designed to demonstrate practical means of mobilizing community action, developing resources, and planning operations. The orientation focused on clarifying low-cost strategies for organizational change in Nkwanta. This process was instrumental not only in facilitating the programmatic shift in Nkwanta but also in providing the Nkwanta DHMT with a model for guiding the national scaling-up initiative.

Implementation milestones

Beginning in a single geographical work zone, community-based health planning and services activities were phased in over time. As additional resources were acquired and community commitment emerged, more zones were introduced. Completing the CHPS agenda requires the achievement of six milestones: planning, community entry, construction of a community health compound, procurement of essential equipment, training and deployment of community health officers, and mobilization of volunteers.

Preliminary planning. The CHPS process is launched by grouping communities into "zones" or service catchment areas to which nurses are eventually assigned.[6] In the case of Nkwanta, attention was focused on developing the optimal configuration of work areas, given the ecology of the area, access to roads and trails, and access to health facilities. Although initially only seven nurses were available for community posting, 16 zones were identified through the mapping and enumeration process. Social and health profiles were developed for each zone, detailing ethnic composition, languages spoken, common traditional practices, and prevalent disease patterns. These profiles were used as the basis for assigning implementation priority to the most deprived areas, as evidenced by high levels of maternal mortality and communicable disease, as well as relative inaccessibility to clinical care. This strategic decision represented an important deviation from the Navrongo model, in that Nkwanta's CHPS zones were delineated in ways that excluded communities lying in close proximity to fixed health-service facilities.

Community entry. "Community entry" refers to the process of meetings, dialogue, and diplomacy involved in launching CHPS. Nkwanta's process of mobilizing

community participation required overcoming a number of obstacles that had not been encountered in Navrongo. Because of the complexity of ethnic composition in the district, a zone might have as many as five languages, multiple chiefs, and heterogeneous patterns of community leadership and social structure. The Navrongo approach of deferring solely to traditional leaders as organizers of community action was, consequently, not appropriate in the Nkwanta setting. Instead, leaders were identified among elected officials, teachers, and clerics. Traditional leaders were involved in honorific rather than organizing roles. Durbars were convened to introduce the various components of CHPS. These meetings, which involve drumming, dancing, speech-making, public debate, and open discussion, played an integral role in building consensus and, ultimately, in fostering community ownership of the program.

Community health compound construction. CHPS draws on community involvement and ownership to organize the construction or renovation of facilities to be used as service points for community-based health care. This effort generally involves convening councils of chiefs and elders and forming liaisons with community leaders to mobilize community volunteer labor for clinic construction. These clinics, referred to as community health compounds, become the residence of the community health officers who are relocated from subdistrict clinics to the village health compounds.

Nkwanta's extreme poverty could have slowed the pace of CHPS implementation in the district. However, the provision of temporary facilities and mobilization of community volunteers to work on renovations facilitated the timely initiation of community health officers' services. As resources were gathered for community health compound construction, priority was given to communities that had launched the program in makeshift facilities. In this manner, resources for construction were used as an incentive to galvanize community commitment and action. Some communities pressed for district development funds; others approached local and national nongovernmental agencies for support.

Procuring essential equipment. In most rural areas of Ghana, households are geographically dispersed, and nurses must have motorbikes in order to provide doorstep services. Even where motorbikes are not available, however, interim CHPS operations can be launched if the population surrounding the community health compound is relatively densely settled.

Deployment of community health officers. As a Ghana Health Service employee, a community health officer is assigned to the community less as a member of the central health bureaucracy than as a member of the community itself. At the time CHPS was launched in Nkwanta, many community leaders viewed the promise of a resident nurse as an incentive for collective action. Through dialogue and negotiation, two communities agreed to provide free access to two abandoned buildings that could be renovated at community expense and used as interim community health compound facilities. The DHMT contributed two motorbikes as well as basic health-care supplies and equipment.

The pilot phase involved both gauging community and staff reactions to the program and identifying areas for improvement. Once services were established, pilot communities served as orientation sites where other community members could observe CHPS in action, develop plans to spread the program, and begin the process of identifying resources essential for CHPS operations. In this respect, community demand for CHPS has defrayed the core costs of compound construction.

National planning for CHPS indicates that although there are approximately 5,300 zones in Ghana, only 2,000 trained nurses are available for deployment. Although this gap in supply and demand indicates the necessity of evaluating and restructuring nurse training programs, immediate strategies are needed to minimize staff turnover and increase recruitment. Nkwanta has explored strategies for improving communications systems to facilitate the community health officer's work and mitigate her isolation. The use of donor-supported radio/telephones has been shown to raise staff morale and service quality in Nkwanta. Community health officers can seek advice about complex cases from one another and from district hospital staff. Rather than traveling for as long as five hours by motorbike to consult the doctor, community health officers can rely on their radio/telephones to determine whether a particular client's health situation warrants referral.

Volunteer selection, training, and deployment. Following their recruitment by village health committees, volunteers complete a six-week course in community health mobilization that emphasizes the promotion of family planning and reproductive health among men. Implementing the program involves convening a durbar to celebrate the introduction of volunteer services, educating communities about referral services, and linking volunteer-based services with community health officers' activities and clinical services at subdistrict health centers and district hospitals.

When equipped with supplies and medication, volunteers often provide services that extend well beyond the limit of their training and clinical qualifications. Consequently, the "Bamako Initiative" approach to volunteer involvement that was promoted in Navrongo has been radically modified by the Nkwanta DHMT. Although Nkwanta's approach includes volunteers as key players, their role is focused exclusively on providing essential support to community health officers through health education, communications, and logistics management. This revised approach was introduced explicitly to minimize the likelihood that volunteers would substitute their clinical interventions for those of more-qualified paramedical staff, thereby undermining community residents' positive health-seeking behavior.

The Nkwanta process of adapting Navrongo's strategies to local needs produced an operational design that differs slightly from the parent model, but that is nevertheless guided by common principles of improving access, extending the range of health-care options, enhancing service quality, and building the social compatibility of the system of care.

The Nkwanta approach to phasing in the CHPS initiative generated variance in service coverage that is used here to assess the impact of service in areas covered by the CHPS program relative to health-seeking behavior and outcomes in areas it does not yet serve. A survey was conducted in 2002 to provide a low-cost appraisal of the impact of the Nkwanta approach to implementing CHPS.

Data collection

Under an initiative created by the World Health Organization, district and regional technical teams throughout Ghana have been trained to assess family planning practice, immunization coverage, and health-seeking behavior in a "30-cluster survey" approach. This procedure, which is known as the "rapid survey method," has been promoted as an inexpensive scientific means of evaluating the impact of family planning programs, maternal health initiatives, expanded programs in immunization, and initiatives focused on health care for children (Lemeshow and Robinson 1985; Frierichs and Tar Tar 1989). Originally developed for applications in Asia, the rapid survey method has been used for descriptive epidemiological and sociodemographic assessments, with a limited application to formal evaluation of the impact of service-system change on health and family planning. CHPS has been designed to adapt the method for evaluating the effects of exposure to program components on changes in provision and use of services, coverage, and health outcomes.

In October 2002, Nkwanta District served as a demonstration ground for the development and testing of a monitoring and evaluation instrument for advanced CHPS districts. The CHPS survey tool included a household questionnaire and an individual questionnaire directed at all women aged 15–49 living in the selected households.

The survey aimed to evaluate covariance of exposure to CHPS and change in health-seeking behavior and health knowledge and outcomes. For the purposes of the district evaluation, 60 clusters were randomly selected by probability proportionate to size, with enumeration areas acting as the unit of analysis or cluster. Prior to cluster selection, the list of enumeration areas was stratified by subdistrict to ensure geographical distribution and to minimize standard error. Interviews were administered to 891 heads of household, 1,064 women aged 15–49, and 180 community leaders, health officials, and school personnel.

Dependent variables

Although the CHPS initiative targets a broad range of preventive and clinical services, the following analysis focuses exclusively on family planning and safe-mother-hood indicators. Because Demographic and Health Survey (DHS) and management information systems data from Nkwanta suggest low prevalence of family planning knowledge and use and high rates of maternal mortality and morbidity prior to the introduction of CHPS, these areas have been critical priorities of the district health management team.

Safe-motherhood indicators. This analysis examines the effect of exposure to CHPS on safe-motherhood practices among respondents who reported having experienced a pregnancy within the past five years. Safe motherhood, for the purpose of this analysis, is defined as receiving maternal health services from a trained health professional. The Ghana Health Service defines "trained health professional" as a doctor, nurse, community health officer, or midwife; neither trained nor untrained traditional birth attendants are included in this definition. Logistic regression was used to model how CHPS exposure and other relevant factors are associated with three indicators of safe-motherhood services: antenatal care received from a trained health professional during the most recent pregnancy;[7] assistance received from a trained health professional during the most recent delivery; and postnatal care received from a trained health professional after the most recent delivery.[8] Three corresponding logistic regression models assess the effect of CHPS exposure on health indicators, adjusting for the possible confounding effects of the respondent's background characteristics, household-wealth indicators, and cluster distance to the nearest health facility.

Family planning. All women included in the sample were asked the question: "Do you know of any methods to delay or prevent pregnancy?" Interviewers then asked respondents to list all the methods they know. Those who knew of a method were asked if they were currently practicing contraception. A binomial regression model assesses the effect of CHPS exposure on knowledge of family planning. Multinomial regression models are then employed to examine the effect of living in a CHPS zone on contraceptive use and nonuse, relative to the odds of not knowing about a method, controlling for geographic, demographic, and socioeconomic characteristics.

Covariates

Exposure to CHPS. Exposure to the CHPS program is defined as a dichotomous dummy variable for the location of clusters relative to CHPS service zones where the program was either functioning or not yet implemented. This discrete exposure indicator is used, even though number of months of exposure to the program varies by CHPS zone. Table 1 displays duration of program exposure in the eight CHPS zones that were surveyed in Nkwanta District. As the timeline illustrates, discrete indicators of exposure time to CHPS capture most of the zone-specific effect.

Moreover, as Table 1 illustrates, exposure to CHPS was skewed in that 70 percent of the sample was unexposed to the program at the time of the survey. Further complicating the estimation of exposure, DHMT supervisors launched CHPS in two of the eight exposed zones, only to suspend operations subsequently when it became apparent that readiness for the program was lacking and community involvement in building the community health compound was not progressing. One of these zones (Tinjase/Azua) had reinitiated services by the survey date, whereas the Sibi zone did not resume services until after October 2002.

Preliminary analyses (not shown) treating months as a categorical predictor confirmed that the association between longer duration of the program and the odds of receiving safe-motherhood care was nonlinear with respect to duration of CHPS. Substantial heterogeneity was observed even though odds ratios for each of the eight exposure groups were almost always greater than one at statistically significant levels relative to those unexposed to the program, controlling for geographical remoteness and relevant demographic and household-wealth variables. Additionally, because all women in the 17-month, 25-month, and 57-month groups had received antenatal care, months could not be used as a categorical factor for exposure. Finally, although duration represents one measure of exposure, it does not reflect the relative intensity of the program in terms of visits per month, training of the community health officers, or supplies available across communities or over time.

One advantage of analyzing CHPS as a dummy variable is that it allows assessment of the overall effect of the CHPS program that could be useful to health policymakers in other districts. Because intensity of service and adoption of the program inevitably vary among communities in a research setting that is not controlled, examining the average effect of CHPS in Nkwanta District approximates a realistic outcome of implementing the program in other settings.

A fundamental limitation of this dichotomous designation for CHPS is that safe-motherhood behaviors are reported for pregnancies that occurred during the five years preceding the survey. All but one of the CHPS zones were exposed to the program for between one and two years, however. Although the argument might be made that an effect of CHPS might reflect baseline differences between CHPS and non-CHPS areas with respect to safe motherhood, an analysis comparing the individuals in the area that had benefitted from 57 months of the CHPS program with individuals who had not been exposed to the CHPS program suggests that such a circumstance is not likely to be the case. For postnatal care and delivery attendance, the odds ratios for women exposed to CHPS for 57 months were 7.28 (confidence interval [CI] 3.37–15.71) and 2.75 (CI 1.08–7.03), respectively, relative to women having no exposure to the program, controlling for distance, demographic, and household-wealth variables. Thus, strong results from the 57-month zone suggest that the observed effects of CHPS are more likely to be underestimates of the effect that would be expected if all women had been exposed for the entire five years.

Distance to nearest health facility. The distance to the nearest health facility represents a potential confounding factor because CHPS zones were selectively designated in remote areas. For each cluster included in the sample, distances to the nearest stationary health facilities and community health compound were measured by odometer. Because the objective of this analysis is to determine whether the CHPS program is associated with access to health services, this variable represents the distance to the closest dispensary, subdistrict health center, or hospital. Distances to the nearest community health compound are not included in this measure because this distance would duplicate the CHPS independent variable.

Age.   Demand for and acceptance of antenatal care may covary with the age of the mother. For example, women who have experienced obstetric complications may be more likely to seek antenatal care for subsequent pregnancies, and multiparous women tend to be older. In this case, cross-tabular analysis of antenatal care by age of mother indicates that a higher proportion of younger women received antenatal care when compared with their older counterparts.

Ethnicity.   Ethnolinguistic identity was included in the model to ensure that the effect of exposure to CHPS on health-seeking behavior was not being confounded by cultural factors associated with tribal affiliation or ethnic background. Of the 15 tribes and ethnic groups reported by female survey respondents, Ewe and Kokomba were most prevalent, with all others representing less than 5 percent of the total sample. Approximately 30 percent of all Kokomba and women of "other" ethnicities in the sample were exposed to CHPS, whereas slightly more than 20 percent of Ewe women in the sample were exposed to the program. Anecdotal evidence suggests that the Kokomba are culturally unique in terms of health-seeking attitudes and practices. For example, Kokomba women are historically expected to give birth alone in a room, because pleas for help are perceived as evidence of conjugal infidelity. In addition, the Kokomba are purportedly more averse to accepting medical advice or care from providers of a different background than are individuals of other ethnicities.

Religion. Cross-tabular analysis of safe-motherhood data suggests that a higher percentage of Christian and Muslim respondents received safe-motherhood care, compared with women reportedly practicing traditional religion or no religion. The analysis also indicates that women in the latter two categories were more likely than Christian or Muslim women to receive CHPS program services. As with ethnicity, the religion variable is included in the model to ensure that religious affiliation is not confounding the effect of CHPS on safe-motherhood practices.

Educational attainment.   Only 3 percent of the women interviewed reported having received a secondary or higher education. Therefore, this variable was collapsed into a dummy representing no education versus primary education or higher. The effects of education and literacy on health knowledge, practices, and outcomes have been well documented in social research (Cochrane et al. 1980).

Socioeconomic indicators. Because the majority of rural households are not engaged in Ghana's formal-sector economy, household wealth was not assessed by monetary income measures. Instead, household surveys collected information on various proxies for wealth, including building materials used for the roof, floor, and walls of the house; access to a toilet facility; type of fuel used for cooking; and ownership of a bicycle, radio, or television. All housing construction indicators were collapsed into dichotomous factors to distinguish households that represented the extremely poor from

those that were better off. Because they are shared resources, wealth indicators such as safe water source, toilet facility, and electric lighting may be more indicative of community-level development than they are of household wealth. Wealth indicators with the greatest variance between CHPS and non-CHPS groups were selected for inclusion in the regression models. In addition, the employment variable captures respondents who reported either being employed or earning money. Because a woman's access to economic resources can have a significant impact on whether she seeks health care for herself and her children, this variable is included as a proxy for the respondent's level of autonomy.

Design limitations

Whereas true experimental designs are ideal in the context of operations research, applying such methodologies in field intervention studies is often problematic. The random selection of units of observation and subsequent assignment of these units to experimental and control groups are often precluded by ethical, logistic, administrative, and political considerations. Even when randomization is feasible, control over the timing, intensity, and duration of field-based interventions may be undermined by unanticipated circumstances that arise in some or all of the study communities (Fisher et al. 1985).

Because resource limitations in Nkwanta prevented districtwide CHPS implementation, purposive selection of priority zones for the initiative was based, as noted above, on zones' relative remoteness and inaccessibility to essential services. The rationale for this strategy, in light of the program's limited funding, was to reach the district's most deprived, marginalized communities. Differences in the pace of implementation consequently provided areal variance in exposure to CHPS that could be exploited for gauging the impact of the initiative. Although statistical adjustment has addressed a number of exogenous factors, including distance to the nearest health-care facility and educational attainment, other biases may not have been detected. In the case of the Nkwanta District Evaluation Survey, although the duration of program exposure could be determined relatively precisely, fundamental problems arose with endogeneity. Because the program targeted zones according to hypothesized patterns of adversity, an inherent bias exists in the design. Unmeasured factors that led district administrators to designate localities as "deprived" (and therefore entitled to priority status) may lead to underestimates of the effect CHPS has on knowledge and reported behavior. Other community-level characteristics such as gender norms and the degree of political will and mobilization to support community-based efforts to provide health care may also contribute to endogeneity.

Individuals residing in CHPS and non-CHPS areas did not necessarily possess comparable preintervention health-related knowledge and may not have shared common modes of health behavior. If the model indicates, however, that the predictive effect of a CHPS variable is not diluted by controlling for factors typically associated with health-seeking behavior, such as education, religion, wealth, age of mother, or proximity to the nearest Ghana Health Service medical facility, this finding would support the hypothesis

that CHPS has effectively delivered health services to Nkwanta's more remote communities. If positive outcomes are associated with CHPS exposure despite the detrimental social, economic, and demographic factors that are believed to counteract intervention effects, a plausible argument can be made that CHPS strategies are successful even in the context of relative deprivation.

Sample characteristics

Characteristics of the sample are shown in Table 2. Table 3 illustrates that, as intended, CHPS communities were more geographically remote than non-CHPS communities. Comparison of mean distances to nearest health facility for households located in non-CHPS and CHPS zones shows that CHPS villages are farther away from the closest clinic, health center, or hospital. On average, women in CHPS zones lived more than 8 kilometers farther from the closest static Ghana Health Service facility than women residing in non-CHPS areas. Women in CHPS areas were also less likely to have a regularly scheduled market in their community. Female respondents in CHPS areas were less likely to have received a primary education but were more likely to report either being employed or earning money compared with their counterparts in non-CHPS areas. On the whole, the household-wealth characteristics analyzed at the individual level confirm that Nkwanta District's population is generally deprived: fewer than half of women surveyed came from households with a safe water source, such as a well or borehole; 29 percent came from households that used any type of toilet; 14 percent came from households with electric lighting; and 8 percent came from households that had access to any type of motor vehicle.

RESULTS

Table 3 presents a comparison of the characteristics of 831 women from CHPS and non-CHPS areas who reported having been pregnant in the past five years.[9] The table shows that similar proportions of women received antenatal care from a medical professional and reported that their most recent delivery was attended by a trained health professional. Heterogeneity is found, however, among the non-CHPS women, much of which is accounted for by the variance in their access to care (not shown). The largest differential between women in CHPS and non-CHPS areas is with respect to postnatal care; more than half of CHPS women reported having received postnatal care from a doctor, midwife, nurse, or community health officer, compared with slightly more than one-third of the women residing in non-CHPS areas.

Two logit regression models were used to evaluate the effect of exposure to CHPS on respondents' receiving safe-motherhood care, as shown in Table 4. The first model tests the gross relationship between CHPS exposure and the outcome of interest, controlling for geographical remoteness. The second model controls for geographic, demographic, and socioeconomic characteristics.

Logistic regression results are consistent with the hypothesis of the impact of CHPS on safe-motherhood care, irrespective of the exogenous control variables included

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in the model. Notable differences in the magnitude of effects are indicated in the table, however.

The odds ratios suggest that exposure to the CHPS program is a determinant of receiving safe-motherhood care over and above the effects of proximity to the nearest pre-CHPS health facility. After adjusting for remoteness, CHPS is associated with an 88 percent increase in the odds of receiving antenatal care relative to receiving it in areas not exposed to the program. CHPS is also associated with a 74 percent increase in the odds of delivery attended by a trained health professional, as well as more than a three-times-greater odds of receiving postnatal care, holding all else constant. The model is thus consistent with the hypothesis that CHPS improves access to safe-motherhood services, even if adjustment is made for geographic access to fixed clinical service points.

Because CHPS zones were selected from especially deprived communities, poorer women were more likely to be exposed to the program, controlling for indicators of poverty. Although building the model further to include socioeconomic indicators reduces the associated CHPS odds ratio, the effect of CHPS remains robust for all three safe-motherhood indicators. The Ewe and other ethnolinguistic groups have greater odds of reporting delivery attendance by a trained medical professional compared with the Kokomba ethnolinguistic group. Moreover, female educational attainment is a predictor of antenatal care. When demographic and socioeconomic characteristics are added to the model, several of the household-wealth indicators are associated with a significant increase in the odds of receiving safe-motherhood services. For example, Model 2 indicates that having access to a safe water source is associated with more than two times the odds of receiving antenatal care compared with the odds of receiving it among women lacking a safe water source, with all else constant. Similarly, cooking with fuel other than wood is associated with four-times-greater odds of having a delivery attended by a trained health professional than if wood fuel is used for cooking. These relationships can be attributed either exclusively to wealth or to a combination of wealth, gender relations, and opportunity costs related to female physical labor in the household.

Although CHPS is consistently associated with an increase in the odds of receiving antenatal care, the findings from this analysis suggest that further study is required to determine the content and quality of these visits. The practical implications of these differences are perhaps more significant than statistics suggest. Because CHPS zones were prioritized based on their relative remoteness, screening for high-risk cases in these communities is arguably of more critical urgency than it is in those communities that have better access to emergency obstetric care. Thus, these findings may understate the true impact of the Nkwanta CHPS program on neonatal and maternal outcomes.

Family planning

Women reporting knowledge of at least one method of family planning were asked if they were currently doing anything to delay or prevent pregnancy. Table 5 reports respondents' family planning knowledge and use differentials for those exposed to the CHPS program and for those not exposed to it. Of those respondents reporting family planning knowledge (35 percent of the total sample), 29 percent in CHPS areas

and 21 percent in non-CHPS areas reported that they were currently practicing family planning. If all women who reported no knowledge of family planning are assumed to be nonusers, then 13 percent of the sample of women in CHPS areas and 7 percent of the sample of women in non-CHPS areas were practicing family planning at the time of the survey. Nonusers were asked to report their reasons for nonuse (not shown). Stated reasons varied widely among those respondents who reportedly knew of at least one method but were not doing anything to delay or prevent pregnancy. Partner's opposition, which accounted for 14 percent, and desire for more children, which accounted for 17 percent, were the two most common reasons given. Together, breastfeeding and pregnancy constituted 18 percent of all responses.

Of those practicing family planning, an injectable contraceptive was the most commonly used method: 62 percent of respondents in CHPS areas and 44 percent in non-CHPS areas cited injectables as their primary method of preventing pregnancy. Only 1 percent of these respondents cited condoms. When asked where they go most often to receive family planning services, more than two-thirds of women in CHPS areas and 35 percent of women in non-CHPS areas cited the community health officer or community health compound. Assuming that this finding is not the product of recording error or misclassification, it suggests that the community health officer is an important family planning resource for women living both within and beyond the boundaries of the CHPS zone.

Table 6 reports logistic regression estimates of the effect of CHPS exposure on family planning knowledge. Odds ratios suggest that exposure to CHPS increases the odds of family planning knowledge twofold, as shown by Model 1. Extension of the model to include multivariate controls has no appreciable effect on estimated odds. Results are thus consistent with the hypothesis that the CHPS program successfully introduced information about family planning to the study population.

Table 7 extends the analysis of family planning knowledge to address the question of whether CHPS translates knowledge into practice. Multinomial logistic regression relative risk ratios reported in the table assess the impact of CHPS exposure on use of contraceptives, relative to not knowing about any contraceptive method, controlling for pregnancy within the last five years and for respondents' geographic, demographic, and socioeconomic characteristics. Results suggest that CHPS not only generates knowledge of family planning (as indicated by the 1.82 relative risk ratio for nonusers who know a method), but also encourages the practice of family planning once a method is known (relative risk ratio = 3.33). Thus, although family planning practice remains low in the study area, CHPS is introducing contraceptive information and fostering the translation of knowledge into practice. Moreover, the estimated impact of the CHPS program, although significant, may be diluted by denial of family planning knowledge and practice.[10]

The analyses reported in Tables 6 and 7 attest to the importance of statistical controls. Having been pregnant within the last five years, for example, is also significantly associated with more than two-times-greater odds of reported family planning knowledge ($p<0.01$ for both variables). Moreover, not practicing any religion is associated with 38 percent lower odds of knowing of a method of family planning as

compared with the odds for Christian respondents (p<0.05). Identifying as Muslim is associated with more than two-times-greater odds of knowing a method (p<0.01), suggesting that religious affiliation is a crucial factor for consideration when providing community members with counseling and services.

As Table 7's relative risk ratios show, having a primary education has a significant positive association with both knowledge of family planning and the translation of this knowledge into practice.

Despite the important impact of these covariates, and evidence of correlation with exposure to the CHPS program, regression estimates suggest that the impact of CHPS is not an artifact of the background characteristics of individuals, families, or location. Findings are consistent with the hypothesis that exposure to CHPS has an impact on women's receiving safe-motherhood care and on indicators of family planning practice.

CONCLUSION

Although health managers in Nkwanta District faced numerous challenges in launching CHPS, their successful adaptation of the Navrongo service model represents a vital intermediate step in the advancement of CHPS as national policy. Based on the Navrongo model, which emphasizes collective ownership and decisionmaking, Nkwanta has shifted its health-service-delivery strategies from clinic-focused to community-based, using a pilot test and qualitative research to guide the process. By adapting the model to the local context, Nkwanta has established that the Navrongo approach is less a boiler-plate model for replication than a process for community-based development of optimal care. Nkwanta has, in essence, tested and confirmed the transferability of the Navrongo model under the realistic conditions of a district that lacks a sophisticated research infrastructure. The program's success in Nkwanta has thus achieved two aims: demonstrating that replication can work, and demonstrating feasible means of scaling up CHPS implementation in other districts.

With this evidence, the Ghana Health Service is currently promoting the CHPS initiative as its primary strategy for realizing universal access to health care. Nkwanta's role in guiding national policy demonstrates the importance of developing strategies for bridging the gap between research-based innovation and broader health-sector reform. In the absence of the advanced demographic and social research capabilities of the NHRC, the Nkwanta initiative provides a credible and well-researched adaptation of the Navrongo model. This process has demonstrated that the impact achieved in Navrongo is not a mere product of the special resources of a research initiative, but is relevant to rural impoverished districts elsewhere in Ghana.

Figure 1 Kassena-Nankana District in Upper East Region and Nkwanta District in Volta Region relative to the other 108 districts and eight regions of Ghana
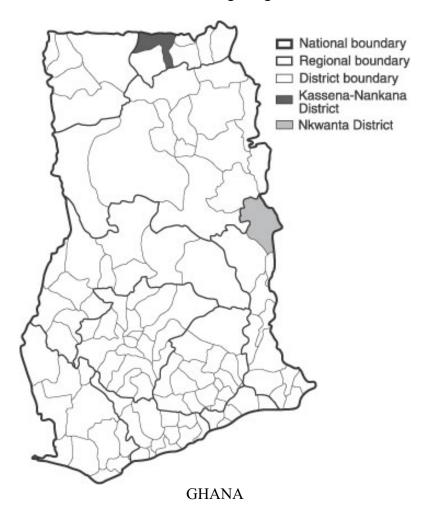

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Table 1 Months of exposure to Community-based Health Planning and Services initiative, by zone, Nkwanta District, Ghana

Zone	1998		1999		2000		2001		2002		
	Jan	Jul	Jan	Jul	Jan	Jul	Jan	Jul	Jan	Jul	Oct
Bonakye/Agou-Fie	January 1998–date of survey (57.01 months)										
Tinjase/Azua			September 1999–September 2000 (12.03 months)								September 2002–date of survey (0.99 months)
Keri					September 2000–date of survey (24.99 months)						
Sibi					October 2000–April 2002 (17.98 months)						
Kecheibi							January 2001–date of survey (20.98 months)				
Bontibor							January 2001–date of survey (20.98 months)				
Obanda							January 2001–date of survey (20.98 months)				
Nyambong							May 2001–date of survey (17.03 months)				

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Table 2 Household characteristics of the Nkwanta District Evaluation Survey sample, Nkwanta District, Ghana, 2002

Characteristic	Non-CHPS	CHPS	Total
Number of households	651	240	891
Number of female respondents	772	292	1,064
Number of children younger than five	887	339	1,226
Total household population	4,262	1,496	5,758
Mean household size	6.55	6.23	6.46
Mean number of children younger than five per respondent	1.15	1.16	1.15
Mean age of household head	44.36	43.54	44.13
Female-headed households (percent)	5.56	5.93	5.66

Table 3 Mean proportions of 831 female survey respondents who reported having been pregnant in the past five years, by selected cluster, household, and maternal background characteristics, according to their exposure to the CHPS program, Nkwanta District, Ghana, 2002

	Mean[a]		
Variable	**Non-CHPS** **(N = 595)**	**CHPS** **(N = 236)**	**Total[b]** **(N = 831)**
Cluster variable (individual level)			
Distance (kilometers) to nearest			
clinic, health center, or hospital	11.6	19.8	13.9**[b]
Market in community	0.66	0.34	0.48**
CHPS program established	0.72	0.28	1.00
Respondent's characteristics			
Religion			
Christian	0.48	0.45	0.47
Muslim	0.09	0.07	0.87
Traditional	0.26	0.29	0.27
None	0.16	0.19	0.17
Ethnicity			
Kokomba	0.50	0.53	0.51
Ewe	0.16	0.11	0.14
Other	0.34	0.36	0.35
Age (years)	30.5	29.5	30.2
Primary+ education	0.29	0.25	0.28
Employed or earns money	0.74	0.81	0.76*
Safe-motherhood outcome			
Received antenatal care from			
medical professional	0.81	0.86	0.82
Delivery attended by medical			
professional	0.23	0.23	0.23
Received postnatal care from			
medical professional	0.36	0.51	0.41**
Household-wealth indicator			
Safe water source	0.46	0.46	0.46
Radio	0.51	0.51	0.51
Television	0.04	0.03	0.04
Refrigerator	0.64	0.03	0.05
Toilet-facility access	0.32	0.22	0.29**
Electric lighting	0.15	0.11	0.14
Corrugated roof	0.49	0.57	0.51*
Flooring other than mud	0.70	0.82	0.74**
Cooking fuel other than wood	0.09	0.04	0.08*
Bicycle	0.63	0.63	0.63
Motorbike	0.04	0.08	0.05*
Tractor	0.00	0.00	0.00
Car	0.03	0.01	0.03
Any motor vehicle	0.07	0.09	0.08

*Significant at p<0.05; ** p<0.01.

a With the exception of distance and age, all means cited above are proportions based on dummy variables.

b Statistical tests are tests of the difference in CHPS versus non-CHPS means for all variables except religion and ethnicity, where p-value corresponds to a chi-square test.

Table 4 Among 831 survey respondents who reported having been pregnant in the past five years, odds ratios in two logit regression models showing effect of exposure to the CHPS program, distance to nearest health facility, and respondent's background characteristics on receiving antenatal care, having a delivery attended by a health-care professional, and receiving postnatal care, Nkwanta District, Ghana, 2002

Covariates	Antenatal care		Attended delivery		Postnatal care	
	(1)	(2)	(1)	(2)	(1)	(2)
CHPS program established						
No (r)		1.00		1.00		1.00
Yes	1.88**	1.79*	1.74**	1.79*	3.09**	3.20**
Distance (kilometers) to nearest						
pre-CHPS facility	0.96**	0.98	0.94**	0.96**	0.95**	0.95**
Respondent's characteristics						
Age		1.00		1.00		1.01
Ethnicity						
Kokomba (r)		1.00		1.00		1.00
Ewe		1.18		2.78**		0.67
Other[a]		1.46		2.28**		0.94
Religion						
Christian (r)		1.00		1.00		1.00
Muslim		1.58		0.80		1.16
Traditional		0.68		0.52*		0.84
None		0.50*		0.45*		1.02
Primary education						
No (r)		1.00		1.00		1.00
Yes		2.15*		1.42		1.44
Employed						
No (r)		1.00		1.00		1.00
Yes		1.12		1.08		0.78
Household-wealth indicator						
Safe water source						
No (r)		1.00		1.00		1.00
Yes		2.63**		1.37		1.84**
Radio						
No (r)		1.00		1.00		1.00
Yes		1.24		1.10		1.33
Toilet-facility access						
No (r)		1.00		1.00		1.00
Yes		1.45		1.56*		0.80
Electric lighting						
No (r)		1.00		1.00		1.00
Yes		3.31		0.96		1.66
Roofing material						
Nonmetal (r)		1.00		1.00		1.00
Corrugated		1.20		1.13		1.02
Flooring material						
Mud (r)		1.00		1.00		1.00
Other		1.55		1.87*		0.85
Cooking fuel						
Wood (r)		1.00		1.00		1.00
Other		5.98		4.33**		1.52
Bicycle						
No (r)		1.00		1.00		1.00
Yes		1.23		1.31		0.85
Any motor vehicle						
No (r)		1.00		1.00		1.00
Yes		0.65		2.01		1.08
Number of household members per bedroom		0.93		0.93		0.87**
Chi-square	21.58	134.29	40.61	194.29	64.51	121.77
(degrees of freedom)	(2)	(20)	(2)	(2)	(2)	(20)
(N)	(831)	(816)	(816)	(801)	(817)	(802)

*Significant at p<0.05; ** p<0.01.   (r) = Reference category.

[a] "Other" includes 14 ethnolinguistic groups, each representing less than 5 percent of the sample population.

Table 5 Mean proportions of all women surveyed in CHPS and non-CHPS clusters, by family planning outcome variables, Nkwanta District, Ghana, 2002

Family planning outcome	Non-CHPS		CHPS		Total	
	Mean[a]	(N)	Mean[a]	(N)	Mean[a]	t-test p-value
Knowledge of at least one contraceptive method	0.33	(770)	0.43	(289)	0.35	0.002
Current contraceptive use[b]	0.21	(252)	0.29	(126)	0.24	0.089
Obtains method most often from community health officer or compound	0.35	(210)	0.68	(113)	0.47	0.000

[a] Mean is calculated for continuous or dichotomous variables.

[b] Only women who reported knowledge of a method to delay or prevent pregnancy were asked about current contraceptive use.

Table 6 Multiple logistic regression parameters for the effect of survey respondent's exposure to the CHPS program, distance to service point, respondent's background characteristics, and household-wealth indicators on her unprompted knowledge of any family planning method, Nkwanta District, Ghana, 2002

Covariates		**Unprompted knowledge of one or more family planning methods (N = 1,035)**	
		(1)	**(2)**
CHPS program established			
No (r)		1.00	1.00
Yes		2.02**	2.12**
Distance (kms) to nearest pre-CHPS facility		0.97**	0.98**
Respondent's characteristics			
Age			1.02**
Ethnicity	Kokomba (r)		1.00
	Ewe		1.75*
	Other[a]		1.56*
Religion	Christian (r)		1.00
	Muslim		2.89**
	Traditional		0.85
	None		0.62*
Education	None (r)		1.00
	Primary+		2.23**
Employed or earning money	No (r)		1.00
	Yes		1.26
Marital status	Unmarried (r)		1.00
	Married		1.02
Pregnant in last five years	No (r)		1.00
	Yes		2.75**
Household-wealth indicator			
Water source	Unsafe (r)		1.00
	Safe		1.49**
Radio	No (r)		1.00
	Yes		1.28
Toilet-facility access	No (r)		1.00
	Yes		0.89
Electric lighting	No (r)		1.00
	Yes		1.14
Roofing material	Nonmetal (r)		1.00
	Corrugated		0.87
Flooring material	Mud (r)		1.00
	Other		1.42
Cooking fuel	Wood (r)		1.00
	Other		1.69
Bicycle	No (r)		1.00
	Yes		0.59**
Motor vehicle	No (r)		1.00
	Yes		1.34
Number of household members per bedroom			0.94
Chi-square (degrees of freedom)		26.43 (2)	185.83 (22)

*Significant at p<0.05; ** p<0.01.   (r) = Reference category.

[a] "Other" includes 14 ethnolinguistic groups, each representing less than 5 percent of the sample population.

Table 7 Multinomial logistic regression parameters for the effect of exposure to the CHPS program, distance to service point, respondents' characteristics, and household-wealth indicators on use and nonuse of contraceptives relative to not knowing of any family planning method, Nkwanta District, Ghana, 2002

Covariates		Relative risk ratios for knowing about but not practicing contraception compared with not knowing about contraception		Relative risk ratios for knowing about and practicing contraception compared with not knowing about contraception	
		Ratio	z	Ratio	z
Exposure to CHPS		1.82	+3.07**	3.33	+3.82**
Distance (kms) to nearest non-CHPS facility		0.98	−2.34**	0.96	−2.22*
Respondent's characteristics					
Age		1.02	+1.99*	1.04	+2.63**
Education	None (r)	1.00		1.00	
	Primary+	2.34	+4.24**	1.92	+2.08*
Employed or earning money	No (r)	1.00		1.00	
	Yes	1.12	+0.60	2.01	+2.06*
Marital status	Unmarried (r)	1.00		1.00	
	Married	0.92	−0.31	1.92	+1.12
Pregnant in last five years	No (r)	1.00		1.00	
	Yes	0.38	−4.16**	0.31	−2.93**
Ethnicity	Kokomba (r)	1.00		1.00	
	Ewe	1.76	+2.08*	1.75	+1.27
	Other	1.50	+1.85	1.82	+1.75
Religion	Christian (r)	1.00		1.00	
	Muslim	0.34	−3.28**	0.16	−3.13**
	Traditional	0.90	−0.45	0.71	−0.97
	None	0.80	−0.90	0.19	−2.99**
Household-wealth indicator					
Water source	Unsafe (r)	1.00		1.00	
	Safe	1.42	+2.10*	1.73	+2.08*
Radio	No (r)	1.00		1.00	
	Yes	1.12	+0.68	2.17	+2.72**
Toilet-facility access	No (r)	1.00		1.00	
	Yes	0.90	−0.57	0.85	−0.57
Electric lighting	No (r)	1.00		1.00	
	Yes	1.11	+0.42	1.21	+0.51
Roofing material	Nonmetal (r)	1.00		1.00	
	Corrugated	0.88	−0.76	0.94	−0.24
Flooring material	Mud (r)	1.00		1.00	
	Other	1.43	+1.77	1.36	+0.87
Cooking fuel	Wood (r)	1.00		1.00	
	Other	1.56	+1.47	2.17	+1.81
Bicycle	No (r)	1.00		1.00	
	Yes	0.50	−4.05**	1.08	+0.27
Motor vehicle	No (r)	1.00		1.00	
	Yes	1.52	+1.44	0.89	−0.22
Number of household members per bedroom		0.92	−1.57	1.03	+0.39
Chi-square (degrees of freedom)		226.95 (44)		226.95 (44)	
Sample size (N)		(1,034)		(1,034)	

* Significant at p<0.05; ** p<0.01.   (r) = Reference category.

NOTES

1   The term "Hawthorne Effect" is a reference to a study by Roethlisberger and Dickson (1939) that showed in an incentive study that factory workers' improved performance was related to the fact that the workers were being observed rather than to the incentive itself. The term refers more generally to the hypothesis that field experiments generate management, organizational, psychological, and resource circumstances that differ from the routine institutional context of large-scale systems that the results of the research are intended to influence.

2   Navrongo focus-group sessions indicated that clinical staff often were perceived as arrogant and insensitive. Community respondents were, therefore, skeptical of schemes that would involve posting clinical staff to their communities. In response to this climate of opinion, nurses known as "community health nurses" were retrained in community-liaison skills, diplomacy, and service quality. Upon completion of their training, community gatherings (*durbars*) were convened to present information about the role of these workers, renamed "community health officers" to signify their new status as true community health-care service providers. This quality-assurance procedure, which was also followed in Nkwanta, has become national policy.

3   The scaling-up strategy in Ghana and the role of Nkwanta in evidence-based program development have been informed by international literature on the determinants of successful scaling-up initiatives. See, for example, Glaser and Taylor 1973; Havelock 1978; Glaser et al. 1983; Rogers 1995; Davis and Howden-Chapman 1996; Simmons et al. 1997; Solo et al. 1998; Binswanger 2000; Bertrand and Marin 2001; and Simmons and Shiffman 2003.

4   A recent review of the literature on the science of scaling up experimental initiatives notes the crucial contribution of mechanisms for linking research-based innovation to large-scale systems (Simmons and Shiffman 2003). Launched initially as an informal program of research dissemination, CHPS was subsequently mandated to develop this linkage process. The Nkwanta project was an initial component of the CHPS program designed to bridge the gap between Navrongo research and large-scale policy deliberations.

5   For at least five decades, social research has demonstrated ways in which ideational change is the function of social interaction shaped by social networks, opinion leadership, and other determinants (see Rogers 1995). More recently, organizational scientists have noted ways in which the principles of diffusion can foster innovation in formal organizations, if action is taken to create the conditions of interaction, networking, credibility, and catalytic policy input. "Change agents" are deemed to be crucial to this process, a role that Nkwanta and Navrongo continue to play in the CHPS program (see Mintrom 1997).

6　To implement CHPS, subdistricts within each of Ghana's 110 districts would be divided into at least six zones. Each zone would be designated to cover a catchment population of 500–5,000 people. According to this projection, national coverage will require approximately 5,280 CHPS zones, necessitating that a minimum of 5,280 community health officers be put in place nationally.

7　A respondent reporting at least one visit was considered to have received antenatal care.

8　A respondent was considered to have received postnatal care if she (distinguished from her infant) was examined by a trained professional at any point during the six weeks following her most recent delivery.

9　Of the 831 women who reported experiencing a pregnancy in the last five years, 15 were missing values for one of the household-wealth factors. No individual had more than one missing value, and these 15 women represent 1.8 percent of the sample. Unpaired t-tests showed no significant difference in means for antenatal care between this group with values missing and the remainder of the sample. Although the 15 women missing data tended to have less education than those in the rest of the sample, unpaired t-tests revealed no statistically significant difference in means for education ($p>0.063$). Removing the five wealth factors with one or more missing values from each of the regressions (thereby adding back the 15 women) did not change the positive effect of CHPS or the significance of the odds ratio for CHPS. Fourteen individuals had blank records for postnatal care. Eight of these women reported that their most recent pregnancy did not go to term, three reported a full-term pregnancy but left postnatal care blank, and three had blanks for both pregnancy outcome and postnatal care. Because women with incomplete pregnancies would not be expected to receive postnatal care, we do not include these women in the unpaired t-tests for difference in means. Unpaired difference of means tests for the remaining six people showed that the individuals with missing records were not statistically significantly different from individuals whose postnatal-care data were complete. This series of tests led us to conclude that the data missing for wealth factors were missing at random rather than being missing for some systematic reason. For approximately half the records missing postnatal-care and birth-attendant data the pregnancy did not go to term, and the other six records were likely missing at random.

10　Field supervisors noted that female respondents appeared to be more timid and less likely to respond frankly to sensitive questions when their husbands remained within close proximity. In clusters in which a local dialect was spoken, women often had to ask their husbands or other male family members to act as translators. Although interviewing procedures are not known to have introduced response bias, confidential, unaccompanied interviews might produce different results. In Navrongo, comparative analysis of survey data with service statistics has shown that 20 percent of known contraceptive users who were interviewed in surveys denied that they were using a method (Phillips et al. 1997).

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